

PATENT SPECIFICATION

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(54) WINDING OF A FIRST LENGTH OF ELONGATE MATERIAL ALONG AND AROUND A SECOND LENGTH OF ELONGATE MATERIAL

(71) We, SIEMENS AKTIENGESSELLSCHAFT, a German company of Berlin and Munich, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

According to one aspect of the invention, there is provided a method of winding a first length of elongate material along and around a second length of elongate material in which the first length runs to a storage arrangement and there forms a coil around and spaced from the second length and it is drawn from the storage arrangement and applied to the second length in such manner as to form a winding along and around it comprising a number of turns in one direction followed by a number of turns in the opposite direction, followed by a number of turns in said one direction, and so on, the winding being secured to the second length of material at least at the reversals.

According to another aspect of the invention, there is provided apparatus for winding a first length of elongate material along and around a second length of elongate material comprising a winding-on device for applying the winding to said second length, means for causing the winding-on device to rotate a plurality of turns in one direction about an axis, a plurality of turns in the opposite direction about the same axis and a plurality of turns in said one direction about said axis and so on, a storage arrangement on which can be formed a coil of the first length of material surrounding said axis on its way to the winding-on device, means for drawing the second length of elongate material along said axis through said coil and an arrangement for applying a means for fixing the first length to the second length at least at the reversals of the winding.

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The second length of elongate material may be, for example, a group of electrical conductors for inclusion in a cable or in a cable core and the first length may be, for example, a marking filament or a paper or plastics tape applied so as to constitute an open or closed electrically insulating or heat-insulating layer, or a metal strip which after application to the first length serves as an electromagnetic shielding means, such as for example a steel strip over the external conductor of a coaxial pair.

The first length may be drawn, to make the coil, from a supply spool or other supply arrangement which is wholly on one side of the axis of the coil and does not rotate around that axis. This makes it possible for the winding process to continue without interruption during the insertion of a fresh supply spool or other supply device.

Preferably the second length is drawn from a store which does not rotate about the axis of any part of the second length and the second length proceeds to where the coil is formed around it, and or the second length with the winding on it passes to a store which does not rotate about the axis of any part of the second length.

The axis of the coil preferably coincides with the axis of that part of the second length which lies within the coil.

Preferably, the storage arrangement is mounted to rotate freely and is caused to rotate by tension in the first length as it is drawn from the storage arrangement by the winding-on device. The latter and the storage arrangement may be mounted on a single fixed tube so as to be rotatable about it.

The first length may pass to the storage arrangement via a storage means which is not rotatable about the axis of the coil and is so constructed that its storage capacity can be varied.

In one of the examples illustrated in the

accompanying drawing, the storage arrangement comprises a tube on the outside of which a coil may be wound and said first length runs on to it from a roller which does not rotate about the axis of the coil but is provided with means for moving it to and fro parallel to said axis, there being a second roller to which said first length runs after leaving the tube, this second roller having means for rotating it about the axis of the coil and for moving it to and fro parallel to said axis. In the other illustrated example the storage arrangement has a curved surface, on which said coil is formed, corresponding in shape to that of the curved surface of a frustrum of a cone.

Where the first length is a paper band, a filament or a cord, it is preferred to secure the winding of it to the second length with an adhesive, whereas when it is a plastics band it could be secured to the second length with the aid of an adhesive or by clamping. For example, there may be applied to the second length, preferably straight along it, before winding on the first length, a band which is coated at least on the outwardly facing side with a layer of adhesive.

If the first and second lengths are both of metal or both of plastics, they may be secured together by welding, for example spot welding.

It is also possible to secure the first length to the second length by using holding clamps or clips which are pushed on to the winding at the reversal points of it.

In order to press the first length against the second length directly after the winding-on of the first length has been effected, there may be employed a device which presses the winding against the second length over a length which is greater than the length of lay of the winding. Such a device may consist for example of two or more "Caterpillar" bands ("Caterpillar" is a Registered Trade Mark) between which the second length travels and which are pressed, through the agency of their tread faces, against the second length.

Two examples in accordance with the invention are described below with reference to the accompanying drawing, in which:—

Figure 1 diagrammatically shows a first apparatus for winding a first length of elongate material along and around a second length of elongate material, and,

Figure 2 diagrammatically shows a second apparatus for the same purpose.

Employing the apparatus 1 shown in Figure 1, a filament 2 is wrapped on a strand-like material 3 with alternately left hand and right-hand lay. The apparatus 1 is arranged co-axial with the illustrated part of the material 3 and consists of a storage

arrangement 6 and a winding-on device 9, which are mounted with the aid of ball bearings 7 and 10 on a stationary, tubular carrier means 5. The storage arrangement 6 is freely mounted for rotation about the carrier means 5, whereas the winding-on device 9 located immediately adjacent it is driven, via a drive 11, which may be for example a friction roller drive, a belt or a gear drive, in opposite directions alternately and winds the filament 2 on the material 3.

At one stage in the operation of the apparatus, whilst winding the filament 2 on the strand-like material 3, a further length of the filament travels from a supply arrangement (not shown), arranged wholly on one side of the axis of the strand-like material and not to rotate around it,

because the storage arrangement 6 is entrained by the winding-on device 9 via the filament 2, so that with each rotation of the winding-on device 9 one turn of the filament 2 travels on to the storage arrangement 6. The storage arrangement 6 has a curved surface, on which a coil of the filament 2 is formed, around and spaced from the material 3, this surface corresponding in shape to that of the curved surface of a frustrum of a cone. Furthermore it is slippery, so that the turns of the filament travelling on to the winding-on device are continuously displaced towards it.

When the storage arrangement has been filled, it is necessary to change the direction of rotation of the winding-on device 9. Then the storage arrangement 6 is emptied by the rotational movement of the winding-on device 9. If the winding-on device would, unless steps were taken to prevent it, take off, on each rotation, from the storage arrangement 6 a length of filament 2 which is greater than that length which it simultaneously wraps on to the strand-like material 3, it is necessary to interpose between the filament supply arrangement (not shown) and the storage arrangement 6 a further storage means (not shown) which does not rotate about the axis of the aforementioned coil and is so constructed that its storage capacity can be varied.

This storage means may be a series of three deflecting rollers arranged in one plane, the spacing between the second deflecting roller and the two other deflecting rollers being variable, or may be a roller storage means. In both cases the storage means causes the storage arrangement 6 to rotate in the opposite direction to the winding-on device 9 and draws some of the filament 2 from it.

The reversal of the direction of rotation of the winding-on device 9 should be effected in the shortest possible time, i.e. with

maximum angular deceleration by means of a braking system, for example an electrical one, and maximum angular acceleration.

- Before the wrapping of the filament 2 on the strand-like material 3, a band 12 which is externally coated with a layer of adhesive is applied on the strand-like material in the longitudinal direction with the aid of *per se* known devices. The adhesive coating on the band 12 may be applied directly before travel of the band into the apparatus 1. If the adhesive applied is such that it will dry sufficiently quickly, it will be possible to dispense with further measures for fixing the filament 2; otherwise, after travelling through the apparatus 1 a covering strip is applied on the adhesive tape so that the filament which has been wound on is sandwiched between two bands. Both bands may be dyed and may thus be used for identifying the strand-like material.

- The apparatus shown in Figure 2 is in particular suitable for the application of a band. Here, sliding of the first length of elongate material on the surface of the storage arrangement is unnecessary. The apparatus consists of a tubular storage arrangement 15, for the first length 19 of elongate material, having a run-on roller 16 displaceable in the axial direction of the second length 20, of elongate material and of two deflecting rollers 17 and 18 which rotate with the winding-on device (not shown) the deflecting roller 17 being also displaceable in the axial direction of the material 20.

- The storage arrangement 15 is mounted for free rotation about the axis of the illustrated part of the material 20. Filling and emptying of the storage arrangement in respect of the band 19 is controlled with the aid of the rollers 16 and 17 which are displaceable to and fro parallel to the band 19. At one stage in the process, the storage arrangement is wound simultaneously towards both sides, commencing in the centre. After reversal of the direction of rotation of the deflecting rollers 17 and 18 connected with the winding-up device (not shown), the storage arrangement 15 is emptied. If, during emptying of the storage arrangement 15, the winding-on device would unless steps were taken to prevent it, take off a quantity of band material which is larger than is wound on the strand-like material 20, then also in the case of this apparatus it is necessary to provide between the supply arrangement (not shown) of band material 19 and the storage arrangement 15 a further stationary storage means (not shown) which takes some of the band from the storage arrangement 15.

WHAT WE CLAIM IS:—

1. A method of winding a first length of elongate material along and around a second

length of elongate material, in which the first length runs to a storage arrangement and there forms a coil around and spaced from the second length and it is drawn from the storage arrangement and applied to the second length in such manner as to form a winding along and around it comprising a number of turns in one direction followed by a number of turns in the opposite direction, followed by a number of turns in said one direction, and so on, the winding being secured to the second length of material at least at the reversals.

2. A method according to claim 1 in which the second length of elongate material is drawn from a store which does not rotate about the axis of any part of the second length of elongate material and the second length proceeds to where the coil is formed around it.

3. A method according to claim 1 or 2 in which the second length of elongate material with the winding on it passes to a store which does not rotate about the axis of any part of the second length of elongate material.

4. A method according to any preceding claim in which the first length of elongate material is drawn, to make said coil, from a supply arrangement which is wholly on one side of the axis of the coil and does not rotate around it.

5. A method according to any preceding claim in which the axis of said coil coincides with the axis of that part of the second length of material which lies within said coil.

6. A method according to any preceding claim in which the winding is secured to the second length of material by applying to the latter, before the winding, a band with outwardly-facing adhesive on it.

7. Apparatus for winding a first length of elongate material along and around a second length of elongate material comprising a winding-on device for applying the winding to said second length, means for causing the winding-on device to rotate a plurality of turns in one direction about an axis, a plurality of turns in the opposite direction about the same axis and a plurality of turns in said one direction about said axis and so on, a storage arrangement on which can be formed a coil of the first length of material surrounding said axis on its way to the winding-on device, means for drawing the second length of elongate material along said axis through said coil and an arrangement for applying a means for fixing the first length to the second length at least at the reversals of the winding.

8. Apparatus according to claim 7 having a store for said second length which does not rotate about the axis of any part

of said second length, from which store said second length is drawn to said storage arrangement.

9. Apparatus according to claim 7 or 8 having a store for said second length which does not rotate about the axis of any part of said second length, to which store said second length, with the winding on it, is drawn.

10. Apparatus according to any one of claims 7 to 9, having a supply arrangement, from which said first length is drawn to said storage arrangement, which supply arrangement is wholly on one side of said storage arrangement and does not rotate about the axis of said coil.

11. Apparatus according to any one of claims 7 to 10 in which the storage arrangement is mounted to rotate freely and is caused to rotate by tension in said first length as it is drawn from the storage arrangement by the winding-on device.

12. Apparatus according to claim 11 in which the winding-on device and the storage arrangement are so mounted on a single fixed tube as to be rotatable about it.

13. Apparatus according to any one of claims 7 to 12 in which said first length passes to said storage arrangement via a storage means which is not rotatable about the axis of said coil and which is so constructed that its storage capacity can be varied.

14. Apparatus according to any one of claims 7 to 13 in which said storage arrangement comprises a tube on the outside of which said coil is wound and said first length runs on to it from a roller which does not rotate about the axis of the coil but is provided with means for moving it to and fro parallel to said axis, there being

a second roller to which said first length runs after leaving the tube, this second roller having means for rotating it about the axis of the coil and for moving it to and fro parallel to said axis.

15. Apparatus according to any one of claims 7 to 13 in which said storage arrangement has a curved surface, on which said coil is formed, corresponding in shape to that of the curved surface of a frustum of a cone.

16. A method of winding a first length of elongate material along and around a second length of elongate material, substantially as described above with reference to Figure 1 or Figure 2 of the accompanying drawing.

17. Apparatus for winding a first length of elongate material along and around a second length of elongate material, substantially as described above with reference to Figure 1 or Figure 2 of the accompanying drawing.

18. An assembly comprising a length of elongate material having another length of elongate material forming a winding on it, this assembly having been formed by a method according to any one of claims 1 to 6 and 16 or an apparatus according to any one of claims 7 to 15 and 17.

19. An assembly according to claim 18 in which the winding has been formed on a group of electrical conductors for inclusion in a cable or in a cable core.

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